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DEVELOPMENT OF MECHANICAL POWER.

Rankine, our most reliable authority on applied mathematics,and the original promulgator of the science of thermodynamics, left us a work called the "Steam Engine and other Prime Movers." The "Other Prime Movers" was in anticipation of the results of the future, for the world has known but one prime motor—the steam engine, using the expansive force of aqueous vapor as its source of energy.

We will not enter into a discussion of those simple devices used to transmit and transform muscular energy, for you are all familiar with the early mechanical movements. The cord and pulley of the ancients in their wells, and the lever theory of the pyramids have attracted your attention.

From earliest times the wind mill and water wheel have been known, and after tracing these appliances far back as our history goes we find that that ever first race—the Chinese—claim the honor of wind and water motors by a priority of 3000 years.

The steam engine up to the present time has been the only great factor in developing the methods of using power to perform nearly all operations that require the expenditure of mechanical energy; the other motors using the energy given directly to us from the sun have been but secondary elements in this development.

The steam engine in its simplest form, and the pioneer of the heat engine is the production of Hero the younger, of Alexandria, about 200 B. C.

It is a remarkable fact that the steam engine remained in a dormant state from the time of Hero's toy until about a century ago when Thomas Newcomen, 1705, made the first move towards devising anything like an efficient machine to use the heat energy of steam.

James Watt soon followed and gave us the heat engine practically as it stands today. The principles embodied in present motors are identical; but through more skillful workmanship their efficiency has been greatly increased.

The steam engine must consist essentially of two parts:

1. A source of heat.

2. Some device that permits the expansive force of steam to do mechanical work.

Hero's engine is the simplest conception. The reservoir is the source of heat, the ball supported on trunnions and provided with bent arms fulfils the second condition.

Newcomen's engine before you consists:

1st. A source of heat, A.

2a. A device for converting the expansive force of steam into mechanical work, consisting of a piston moving in a cylinder and capable of lifting a weight.

Newcomen's engine imposed a third condition to the successful heat motor, namely, a source of cold, or some arrangement, by which the steam, after doing its work, could be condensed.

The piston having reached the top of the cylinder would remain there if the steam did not condense consequently a jet of water was forced into the cylinder, a partial vacuum produced and the piston again forced to the bottom by the pressure of the atmosphere.

In this case the atmospheric pressure directly raised the pump rod, but the steam enabled us to produce the difference of pressure on the two sides of the moving disc.

James Watt, the father of the present steam engine, gave us a device by which steam could be ad-

mitted alternately in each end of the cylinder and exhausted from each end after it had done its work.

Watt differentiated the steam engine. In order to produce mechanical power we must have, as in Newcomen's engine,

1. A source of heat.

2d. A device for converting heat energy into mechanical energy.

3d. A source of cold.

Watt separated these three widely and the steam engine he left us fulfils only the second of these conditions.

The steam plant today consists essentially of these three factors:

1st. The boiler, or source of heat.

2d. The engine, or source of power.

3d. The condenser, or source of cold.

The Watt power plant consisted first, of a boiler. The fuel supplied the heat to a stout cylindrical shell partially filled with water. When the temperature of 212F was reached steam began to be formed, and as long as the heat was applied steam was formed and the pressure continually increased.

The heat was now transfered to the engine and the process of using the steam is as follows:

The steam comes into a box by pipe or other convenient paths. The valve slides on the face of the cylinder. When the piston is at the end of the stroke steam is admitted through an opening and forces the piston from right to left. After the piston has traveled through a certain space the valve closes the port and the engine is moved by the expansion of the steam in the cylinder up to the point at which the port is open to exhaust. When the piston reaches the end of the stroke the steam admission into the left end of cylinder is identical with that on the right.

The source of cold, or condenser, is the next essential of the Watt power plant. The exhaust steam enters the space surrounding the tubes, through which flows cold water, and as a consequence is condensed.

The method of determining the amount of power developed by any engine is of importance. As you all know 33000 pounds raised a distance of one foot in a minute is a horse power. If in any engine we take the pressure of the steam on the piston in pounds, and multiply this by the feet the reciprocating paths of the engine move through in one minute, and divide this product by 33000 we get the horse power of any engine in question.

This determination would be very easy did we always let the pressure from the boiler follow the piston throughout the whole length of the stroke, for the boiler pressure would be the pressure on the piston; but this is not a true state of affairs in an economical engine.

Watt devised an instrument by which the pressure in the cylinder at every point in the stroke could be measured.

A small cylinder having in it a piston resisted by a spring is connected with the cylinder of the engine so as to be in direct communication with the latter. Every change of pressure in the engine cylinder is felt by the movable disc in the indicator. The spring resisting the piston of the indicator is so made that say for 20 pounds pressure per square inch the moving parts will be allowed to move through a distance of one inch.

To the piston of the indicator is attached a rod, the upper end of which carries a pencil.

A board is so mounted and connected to some portion of the engine moving at the same speed as the engine piston, that it has the same relative reciprocating movement as the engine parts. Consequently as the piston of the engine makes one stroke and return a diagram something like the one shown is traced on the board.

This card gives readily the mean effective pressure in the cylinder for one complete revolution, enabling the determination of the horse power of any engine working under any conditions.

With a pair of indicator cards we we are enabled to know the steam distribution in any given engine.

A detailed discussion of what the indicator diagram shows to the engine would be too technical and uninteresting; enough is to say that the building of high grade engines is no longer a matter of cut and try, but designing machinery is based on thorough scientific principles, and the mechanical engineer knows as accurately from his drawing what will be the performance of his engine as he does after making careful tests for efficiency of existing machines.

Every effort has been made by the engineer to increase the efficiency of our greatest prime mover—for the matter of the exhaustion of our fuel has in the last ten years been a topic of serious consideration.

One best type of motors—the marine engine—is the outgrowth of the necessity to increase the carrying capacity of vessels, and to accomplish that end the fuel weight must be decreased, consequently an engine that would develop the maximum amount of power with a minimum amount of fuel was the outcome.

In the marine engine the steam after having done its work in one cylinder passes to a second, develops an equal amount of mechanical energy, passes to a third again performing its work, and in some cases even passing to a fourth cylinder, and then finds its way to the condenser, enabling the final pressure to reach almost zero.

That the present steam engine is almost in a a state of perfection is a common opinion.

We have practically reached the limit of improvement, and if engineers increase the efficiency of the engine .5 of one per cent the results one considered remarkable.

The best designed engine of today, and nearly all engineers concede that the limit of efficiency has been reached, is about the most wasteful device of which we can conceive.

In the simple process of making steam our best boilers utilize only about 60 per cent of all the heat in the fuel i. s., the heat in the resultant steam is only about 60 per cent of the heat in the fuel before it is burned in the furnace.

If we consider the steam engine as a heat engine, we know from the beautiful theory developed from Carnot's cycle that the efficiency of any perfect engine is equal to the difference of the absolute temperatures of the steam at its admission into the cylinder, and its temperature when exhausted divided by its absolute temperature at admission.

In our best marine engines, were they entirely free from internal friction, we find that only about 25 per cent of the total heat in the steam delivered to them is converted into useful work. In short our best type of the only prime mover utilized only about 15 per cent of the heat that is given to it by the fuel—the stored up enegy of by gone ages.

The progress made in electrical science during the past decade indicates that the efficient transformation of mechanical energy into electrical energy and from electrical back to mechanical will work a revolution in the steam engine.

The small engines will disappear and the steam plant of thousands of horse power operating large dynamos will deliver to us over a small wire the electrical energy which will be changed back into mechanical by electric motors to use at our pleasure.

Considered as a prime mover the electric motor is most economical. The mechanical energy given to a dynamo will be transformed into electrical and the electrical energy converted back into mechanical with a loss of only about 5 per cent —a strking contrast to the wasteful steam engine.

But the basis of all our power at present is the heat energy of steam for to produce electricity we must first generate mechanical power; excluding the very small amount of electricity now produced by chemical action.

Let us look for a moment at the theory undelying the present successful dynamos and motors, and one no doubt familiar to you—Faraday's theory of electric energy developed from mechanical power.

Suppose we have two magnets forming between them a magnetic field. If in this field a conductor be moved a current is set up in the conductor in a direction to the right from which the motion originates.

Faraday's law is reversible, if we pass a current in a conductor lying in a magnetic field, the electric energy of the current is transformed into motion—mechanical energy. The latter principle developed the electric motor. Our present system of producing electric energy is dependent entirely on the steam engine, and very few experiments indicate that we will at any time soon be able to convert the energy in fuel directly into the electric current. This is the most important problem now before electrical engineers

The wizard Edison asserts he will leave such a process to posterity, but

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as yet not even the first tangible clue has presented itself.

The engineer now can only solve the problem of producing a more efficient prime mover than the steam engine.

Most scientists concede that electric power is to be the directly applied force of the future, and nearly all are as willing to believe that when the two hundred years supply of coal has been exhausted other prime motors will supply the steam engine.

The solution of the power problem then takes practically this form. The efficiency of the electric developers and transmitters of power must be increased; new prime motors concentrating the power of natural force must be devised.

The last four years has witnessed almost a revolution in electrical science.

The continuous electric current has been almost entirely displaced by the alternating current, and the advantages are apparent.

The flow of the electric current is perfectly anlaogous to the flow of water through a pipe.

The unit of electrical pressure is the volt; the unit of electrical quantity the ampere.

The pressure times the quantity of any body of water gives us the capacity of doing work.

For a given amount of work to be done we must have a certain product, the same work may be performed by either increasing the pressure or the quantity, the other factor being diminished accordingly.

If we desire to operate a water motor at a considerable distance from our water source, the advantage of carrying a high pressure in our water pipes is apparent for the distance of the point of application may be increased as the pressure is increased, the quantity of water is less and the work done the same.

Just so with the electric current the unit of pressure—the volt—multiplied by the unit of quantity the ampere—gives us the unit of electrical work—the watt.

The amount of work that any current will do depends upon the products of amperage and voltage; the voltage, or pressure of electric current flowing in a wire, decreases on account of electrical friction just as the pressure of water—in flowing through a long pipe—decreases.

The drop in voltage in any circuit is almost directly proportional to length of the conductor, the size of conductor remaining constant; therefore it is best to raise the pressure or voltage as high as possible, then the loss by electrical friction is only a small per cent of the total energy transmitted.

The greatest advantage of high voltage is the fact that we are enabled to transmit the power for so great a distance.

The continuous current generated by Edison machine is not of high voltage, the amount of output depending mainly on the amperage or quanity.

The alternating current is of high voltage and small quantity.

This latter machine solves practically the matter of long distance electric railways, and the actual road being built between St. Louis and Chicago is the outgrowth of alternating current electricity.

The alternating current transformer is another device making alternating currents particularly adopted to all conditions of electric transmission.

With the transformer the high voltage current may be converted into a current of any voltage and any amperage.

At our very doors, to which point

the high voltage current is transmitted, with scarcely any loss due to friction, the current is given to us in just the condition we desire it —for doing mechanical work, producing light and heat.

If the voltage of any current could be infinitely increased, for a current of given energy the quantity could be made infinitesimally small, and consequently the conductors could be made practically of no dimensions.

The mo t brilliant and successful investigator of high potential or high voltage currents in Tesla and you are no doubt familiar with the almost incredulous manner in which he proposes to produce artificial light.

Tesla's experiments have added new strength to the theory that light, heat, sound and electricity are all energies originating from a common source and that their peculiar forms are due simply to aether wave motions of varying intensity.

The medical faculty all agree that a current of 1500 to 1800 volts passed through the body will produce instant and painless death.

The voltage of a current is that part producing marked physiological effect. A current of 2000 amperes and low voltage, say 6, passed through the body can scarcely be detected.

Tesla discovered that he could pass through his body an electric current of hundreds of thousands and even millions of volts without the least effecting his nerves.

Just as we can hear sounds within only a narrow limit; can see light up to a certain intensity, so is our experience with the electric current; when the vibrations of the aether increase beyond a certain point. Mr. Tesla discovered that the waves were too short and rapid to make any impression on our nerves.

The present outlook in electrical science seems to indicate that the best talent for sometime to come will be given to the development of high potential motors.

What will be the result if the method of producing light is expanded along the lines indicated by Tesla?

In the near future we will be able to light our homes and cities with a current that penetrates every part of a space only limited by the relation of electrical resistance to voltage.

The matter of wiring up a building in order to produce artificial light will be a thing of the past.

Our homes will be illuminated as if by magic, no particular source of illumination will be apparent, still a soft rich light will fill space by night as the sunshine does by day.

The electrical side of the question disposed of, what prime mover will furnish the power to produce these high potential currents?

When the supply of coal is exhausted for steam producing purposes we will be dependent on active forces in nature.

The power of falling water is becoming a factor in the production of electrical energy. The problem of utilizing the power of Niagara has been solved.

Each water wheel takes its supply of water from the upper river level by means of a separate channel, which being comparatively small may be controlled by gates.

The water after giving up its energy by virtue of its fall is discharged into a large tunnel which empties below the falls.

This system may be carried out indefinitely until practically all the water that now flows over Niagara is made to do work by passing through an immense number of water wheels.

The power developed will be six millions horse power, and were thus utilized in the economical production of electric currents—the matter of long distance transmission being settled by the perfection of the high voltage alternating current—enough power would be developed to supply half of the United States.

Geologists name the life of Niag-

ara Falls as 7000 years.

The great number of rapid rivers in every part of the earth will always be a source of power.

The most novel and recent application of nature's forces for the production of mechanical power, is that relating to the utilization of the power of ocean waves.

The most satisfactory schemes yet devised are those perfected from a series of experiments made by Albert Stahl of the U. S. N., along the Pacific coast.

The matter of collecting the direct rays of the sun and applying them to a heat engine has received some sttention, but solar engines are failures. For some time, at least, the steam engine will develop power from fuel, and the dynamo and motor will transmit and apply it.

To lift a head, or cheer a heart,
That sadness from their lives might part,
And give if friendship has power to give it
A balm of happiness if I could move it,
To dry a tear, or start a smile,
To banish fear or a stay awhile;
A trembling hope or wav'ring faith
That they not grope in wondring path,
Nor live in loss of life's best dream,
Or bear a cross that heavier doth seem
Then should be lot of mortal here
In wand'ring through this mundane sphere.
If among my friends there is one friend
To whom sweet flowers I could send,
And with their joys and joys blend,
Or troubled soul from misery send,
Or in wounded breast a heart to mend,
I'd send some flowers this holiday
And in their language my greetings say.

The above poem is a little deeper than the CADET is in the habit of publishing, and we deem it necessary to give some explanation, else the noble effort falls short of the desired effect.

To begin with it was not written for publication, but was intended to accompany some flowers which a certain young man, young only in the sense that he is unmarried, sent to the lady of his heart.

He is evidently a man "slow to act," which possibly accounts for his single state. Slow, because this was composed some time about Thanksgiving and as yet has never reached its destination. See also how long it takes him to get worked up to his subject "sending flowers," count all previous lines as introductory, then there remains only two lines for the body, and then his muse departs ere he can "wind to a beautiful close."

We are about to fall short of our explanation, but we only meant to give a history of the poem and never had any idea of analyzing the verse. We will say, however, that it can only be appreciated after it is thoroughly memorized and studied in connection with a dictionary.

It seems to us that he began at the wrong end, but poets will be poets. They are not responsible for their conduct, for we must remember that—

"Poets are born, not made."
And when the English
They do raid,
They are never
Dubbed a "Jade";
But they have the credit
Of knowing all—
But our Muse wont respond
To another call.
So with this "dash"
We'll have to quit;
But if she ever returns
We'll tell it "yit."

An old fashioned sea story full of interest and adventure, with a strong love motive, is begun by W. Clark Russell, in the January Cosmopolitan. "Ouida" succeeds Froude, Grosse, Lang, and other distinguished writers with an instalment of the "Great Passions of History" series, which has been appearing in the Cosmopolitan. A discussion is aroused by Mr. Edward Bok's article on "The Young Man and The Church," which will consume tons of ink before it is settled.

The present "Theatrical Season in New York" is critically considered by Mr. James S. Metcalf, editor of Life, and there are stories by Torguee, Howels, and the famous French writer, Francois Coppee.

A sketch from Mrs. Blackburn's geography examination by one of her brightest pupils.

"Subject. Austria, O hungry!
The climate of Austria is very warm
And here they raise a kind of corn.
The Danube winds its way along
And flows into the Black Sea, as shores you born.
The Caucausus mountains in the western part,
And towards my seat I'll take a start.
The principal city is Budhpest;
Now I'll go to my seat and take a rest.

The Patterson Literary Society held its third annual declamatory contest in the college chapel on the evening of the eithteenth, and it was in every respect a success. There were four contestants for the prize, which was a gold medal, valued at ten dollars.

Besides the four contestants from Patterson Society there were also Miss Marie Oldham from the Philosophian, and Mr. Roach, who were to contest with the winner of the medal for representative of the college at the Exposition contest, which was to be held the next afternoon and which was open to all the colleges in Kentucky.

Mr. Case won the Patterson medal and also represented the college at the Exposition.

The subject of Mr. Case's declamation was "The Roman Sentinel." Mr. T. G. Roach declaimed "The Life of Henry W. Grady. He handled his subject well, and even more like an orator than a declamer.

Miss Marie Oldham, who is without doubt an artist in this line, declaimed "How Ruby Played," and was only defeated by one point.

Mr. T. L. Campbell's subject was "The Race Problem." He was highly complimented on his delivery of the piece.

Mr. J. W. Wilmott chose for his subject, "My Country, My Mother, My God!" He delivered it well, but was under disadvantage on account of horseness.

Mr. T. R. Dean was last upon the program, and declaimed "Spartacus to the Gladiators." He handled his subject in a masterly manner and showed that he had studied his subject well.

The medal was presented by Rev. Bolling, and the judges were Prof. Patterson, Rev. Bolling and Supt. Cassidy.

Manager Bush, of the base ball team of 1895, has begun to cast his glances over the students with the intention of organizing the team. There is no reason why S. C. should not win the pennant this year, as she has better material and more of it than ever before, and so hoop up boys and were sure to win.

Mrs. L. C. Brock's Mid-winter declamatory contest will be held at the Opera house, in Cynthiana, on the night of Feb. 15th.

The representatives will be as follows: A. and M., Lexington, sends Mr. D. Morris Case, who will declaim "The Roman Sentinel;" S. B. Harper, Asbury; J. J. Bell, St. Mary's College; E. O. Saunders, Sharpsburg; K. U., Centre and Central University have not yet selected a representatsve.

The L. & N. railroad will sell round trip tickets from Lexington. The admission to the contest for all students from colleges represented in the contest will be free.

Gov. Brown will act as one of the judges.

At the last election of officers of the College Home, the following officers were elected: J. J. Woods President, J. D. Turner secretary, and M. Kirk mail carrier.

Prof. Johnson paid a short visit to Cynthiana last week. We suppose strictly on business.

Miss Hattie H. Warner has returned after a short visit to Miss Nancy Smith, of Cynthiana.

Have you "saw" the june bug of the senior class, if not where have you been "at?"

"Robert Clark" won the Latin Handicap in January exams, with J. J. Dunlap in the saddle.

Profs. White and Wm. Patterson have been sick for the last few days and have been unable to take charge of their classes We hope they will soon be able to resume again, for there are none in our faculty better liked than Profs. White and Patterson.

The Scientific American should have a place in every Dwelling, Shop, Office, School or Library. Workmen, Foreman Engineers, Superintendents, Directors, Presidents, Officials, Merchants, Farmers, Teachers, Editors, Lawyers, Physicians, Clergymen—People in every walk and profession in life, will derive satisaction and benefit from a regular reading of The Scientific American.

We see from his announcement in the Kentucky Telephone that Mr. Denny P. Smith, a graduate of this college, will be a candidate for Representative of his county in the next State Legislature.

The mention of Mr. Smith's name in these columns will awaken many happy reminiscences in the minds of the older students who can recall his career at college. The boys will remember him for his manliness, his success as an athlete, being one of our finest foot ball players, and his power as a debater in the literary societies. The rapidity with which he could grasp a subject and see it in all its phases, the earnestness with which he urged his points, and his masterful eloquence rendered him a formidable oppenent in debate, and it was seldom he left the floor without making even his antagonists see the question in an entirely new light. It was on these occasions that Mr. Smith's friends discovered in him the qualities that go to make a statesman and predicted for him a brilliant future.

The faculty will remember Mr. Smith for his diligence and perseverance as a student. With all, he was a favorite. No study seemed too deep or too difficult for him; however, he seemed to have a special liking for social and political economy, and his thorough study of these subjects render him peculiarly fit for the career upon which he is about to enter. The sciences, also, had a fascination for him, and his profound insight into the mysteries of biology won for him the honors in that department of science upon his graduation.

Both faculty and students will remember the way he supported himself while in college. He was raised upon a farm in Trigg county, and entered the preparatory department of the college in 1888 without money. With nothing save his energy, brawn and brain he supported himself by working about the college until the last year of his course, and stood among the best in his classes, graduating president of the class of '93.

While gratified to hear of the honor which Mr. Smith's county may confer upon him, we are not suspirised, and are of the opinion that he is not more to be congratulated than the people of his county and State in that they may have such an able Representative.